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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/604,731	08/13/2003	Geng Wang	FIS920030209US1	1730

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INTERNATIONAL BUSINESS MACHINES CORPORATION
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EXAMINER	
DANG, TRUNG Q	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 12/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/604,731	WANG ET AL.	
	Examiner	Art Unit	
	Trung Dang	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 August 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *8/13 and 10/22/03*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 4, 9 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art in view of Bindal (US 5,548,148).

The admitted prior art of Fig. 2A teaches a method of forming a deep trench vertical transistor in a semiconductor substrate having a surface and a deep trench with a sidewall formed in said semiconductor substrate and a bitline diffusion region 26 juxtaposed therewith on the surface of said semiconductor substrate, comprising the steps as follows:

forming a deep trench having a top and a lower portion in a doped semiconductor substrate 15;

forming a counterdoped buried plate 42 in said substrate surrounding said lower portion of said deep trench;

forming a storage node dielectric layer 44 as a conformal thin film on inner walls of said deep trench;

filling said deep trench with an initial storage node conductor 11 which is counterdoped;

recessing the initial storage conductor, forming a dielectric collar 12 as a conformal film on exposed inner walls of said deep trench with said dielectric collar recessed below said top of said deep trench;

filling said deep trench with a complementary storage node conductor which is counterdoped above and in contact with said initial storage conductor;

recessing said complementary storage node conductor to a buried strap level 13 in said deep trench;

forming a counterdoped buried strap OD counterdoped out-diffusion by diffusion of dopant from said complementary storage node conductor into said substrate;

forming a trench top oxide layer 14 over said complementary storage node conductor;

forming a gate oxide layer 24 which is conformal with exposed inner walls of said deep trench;

forming a gate conductor 16 in said deep trench above said trench top oxide layer;

recessing the gate conductor below the surface of said semiconductor substrate; and

performing angled ion implantation at an angle θ with respect to vertical of a p-type dopant into said channel below the location of said bit line diffusion region (drain region).

The admitted prior art differs from the claims in not having the step of performing angled ion implantation at an angle $\theta + \delta$ with respect to vertical of a counterdopant into said channel below the location of said drain region.

Bindal teaches that when p-type dopant (boron) implanted into a channel region of an N-channel MOSFET is compensated or counterdoped with arsenic results in high threshold voltage while reducing substrate sensibility and source/drain junction capacitance (col.1, lines 40-55, col. 2, lines 51-60). The dopant and counterdopant are implanted at an angle of 7 degrees (col. 4, line 66).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to counterdoping the implanted p-type dopant of Fig. 2A by performing angled ion implantation at an angle of 7 degrees with respect to vertical of arsenic because the counterdoping would have the benefits as suggested by Bindal. Note that, since the claims do not limit to any value of δ, the claims are met when δ is zero.

2. Claims 2-3, 5-8, 10-11, 13-20 are rejected under 35 U.S.C. 103(a) as being obvious over the admitted prior art taken with Bindal as above and further in view of Chidambarrao et al. (US 6,740,920).

The applied reference has a common inventor with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art only under 35 U.S.C. 102(e). This rejection under 35

U.S.C. 103(a) might be overcome by: (1) a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not an invention "by another"; (2) a showing of a date of invention for the claimed subject matter of the application which corresponds to subject matter disclosed but not claimed in the reference, prior to the effective U.S. filing date of the reference under 37 CFR 1.131; or (3) an oath or declaration under 37 CFR 1.130 stating that the application and reference are currently owned by the same party and that the inventor named in the application is the prior inventor under 35 U.S.C. 104, together with a terminal disclaimer in accordance with 37 CFR 1.321(c). For applications filed on or after November 29, 1999, this rejection might also be overcome by showing that the subject matter of the reference and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person. See MPEP § 706.02(l)(1) and § 706.02(l)(2).

The combination of the admitted prior art and Bindal teaches a method as described above. The combined teaching differs from the claims in not disclosing recessing the gate conductor 16 below the bottom level of the source region 26 (see Fig. 2A).

Chidambarrao teaches that when the angled threshold implantation of boron is performed only in the upper portion of the channel toward the source results in the region of the channel near the drain region has a lower

concentration of dopant than the portion toward the source so that there is less leakage at the channel-drain junction and so that hot-electron effects are reduced (Fig. 4 and col. 4, lines 39-45)

It would have been obvious to one of ordinary skill in the art to modify the admitted prior art by recessing the gate conductor 16 below the bottom level of the source region 26 because this would allow the threshold implantation only in the upper portion of the channel toward the source while keeping dopant concentration low in the region of the channel near the drain as suggested by Chidambarrao. The motivation of doing so is to prevent leakage at the channel-drain junction and reduce hot-electron effects as taught by Chidambarrao.

As for claims 3, 6, 8, 11, 14, 16, 18, and 20, Chidambarrao teaches an angle of between 7-20 degrees for the dopant implant and Bindal teaches dopant and counterdopant could be performed at the same angle, hence the determination of values for θ and δ within said range so as to satisfy the condition as claimed would have been obvious to one skilled in the art since it has been held that, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). In re Kulling, 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990); and In re Geisler, 116 F.3d 1465, 43 USPQ2d 1362 (Fed. Cir. 1997).

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Trung Dang whose telephone number is 571-272-1857. The examiner can normally be reached on Mon-Friday 9:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Trung Dang
Primary Examiner
Art Unit 2823

12/13/04